Claims

1. A user connection element for a force reflecting haptic interface, the user connection element comprising a presence detector comprising:

(i) an electrically conductive portion for contacting a user;

(ii) an electrical circuit; and

(iii) a connector for electrically coupling the conductive portion with the electrical circuit.

2. The user connection element of claim 1, wherein the user connection element is a stylus.

3. The user connection element of claim 1, wherein the electrically conductive portion comprises a conductive rubber.

4. The user connection element of claim 1, wherein the electrically conductive portion envelops substantially an entire external surface of the user connection element.

5. The user connection element of claim 2, wherein the electrically conductive portion extends along an axial and circumferential portion of an external surface of the stylus.

6 The user connection element of claim 1, wherein the connector comprises a spring contact which is biased against an interior surface of the electrically conductive portion.

7. The user connection element of claim 1, wherein the electrical circuit detects a change in capacitance relative to ground due to contact by a user.

8. The user connection element of claim 1, wherein the electrical circuit comprises:

an oscillator for generating a signal;

a signal divider for receiving the signal and generating a first and a second pulse;

a phase detector for receiving the first pulse; and

a variable delay for receiving the second pulse and including an input terminal electrically coupled to the electrically conductive portion, wherein the variable delay delays the second pulse an amount of time before reaching the phase detector when a user is contacting the electrically conductive portion.

9. The user connection element of claim 8, wherein the amount of time of the delay depends on the change in capacitance.

10. The user connection element of claim 8, wherein the user connection element outputs a signal to enable operation of the haptic interface.

11. The user connection element of claim 1, wherein the variable delay includes a surge protector.

12. A wrist rest for a haptic interface, the wrist rest comprising a pad including a contact surface to support an arm or a wrist of a user.

13. The wrist rest of claim 12, wherein the contact surface is substantially planar.

14. The wrist rest of claim 12, wherein the contact pad is concave.

15. The wrist rest of claim 12, wherein the pad further comprises a gel material encased in a covering material.

16. The wrist rest of claim 15, wherein the gel is a soft silicone gel.

17. The wrist rest of claim 15, wherein the covering material is selected from the group consisting of a natural fabric and a synthetic fabric.

18. The wrist rest of claim 12, wherein a height and an orientation of the wrist rest is adjustable to accommodate various user interface elements.

19. A velocity limiting control method for a haptic interface with powered axes, the velocity limiting method comprising the steps of:

measuring the rotational speed of an actuator; and

slowing the actuator when a predetermined maximum actuator speed is exceeded.

20. The velocity limiting control method of claim 19 further comprising the step of determining a maximum actuator speed.

21. The velocity limiting control method of claim 19, wherein the slowing step comprises dynamically braking the actuator.

22. The velocity limiting control method of claim 21, wherein the actuator is a DC motor and the step of dynamically braking the actuator is achieved by shunting leads of the DC motor.

23. The velocity limiting control method of claim 19, wherein the slowing step comprises disabling the actuator.

24. An automatic work volume calibration method for use with a haptic interface, the calibration method comprising the steps of:

initializing a position of the haptic interface; and

geometrically centering a user reference point in a workspace volume and a remote environment.

25. An automatic work volume calibration method for use with a haptic interface, the calibration method comprising the steps of:

rotating a rotary element of the haptic interface;

tracking an angular orientation of the rotary element;

determining a home position for the rotary element; and

centering a user reference point by comparing the angular orientation of the rotary element with respect to the home position of the rotary element.

26. The automatic work volume calibration method of claim 25, wherein an encoder is used to track the angular orientation and determine the home position of the rotary element.

27. The automatic work volume calibration method of claim 25, wherein a proximity switch is used to track the angular orientation and determine the home position of the rotary element.

28. The automatic work volume calibration method of claim 25, wherein a microswitch is used to track the angular orientation and determine the home position of the rotary element.

29. The automatic work volume calibration method of claim 25, wherein a potentiometer is used to track the angular orientation and determine the home position of the rotary element.

30. A system for automatic work volume calibration of a haptic interface, comprising:

at least one rotary element;

at least one flag disposed on the at least one rotary element;

a user interface connection for moving the at least one rotary element through a range of motion thereof; and

means for determining angular orientation of the at least one flag to geometrically calibrate the work volume.

31. The system for automatic work volume calibration of a haptic interface of claim 30 further comprising:

a second flag disposed on the at least one rotary element and forming a gap between the at least one flag and the second flag; and

means for determining angular orientation of the second flag and the gap to geometrically calibrate the work volume.